FOREST RESEARCH DIGEST

MAY-JUNE 1936

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LAKE STATES FOREST EXPERIMENT STATION*

FOREST SERVICE U. S. DEPT. AGR.

THE NORTH DAKOTA BRANCH STATION

The field station at Denbigh, North Dakota was established in 1931 in cooperation with the State Forester to test the feasibility of large-scale afforestation of an area of poor, sandy, non-agricultural land located in the north-central part of the State. Most of this area is in McHenry County. The purpose of this work was to determine whether there should be a national forest established in North Dakota similar to the Nebraska National Forest.

The first plantings were made in 1931 and to date about 300 acres have been planted.

Some 20 to 30 species are being tested. Of these the following to date have shown best possibilities: cottonwood, red cedar, green ash, Ponderosa pine, and jack pine.

The planting "chances" can be grouped roughly into two classes:(1) dune sand and, (2) sand "flats".

There is not much grass competition on the areas of dune sand, and planting technique similar to that developed on the Nebraska National Forest is used. The sand flats are level to gently undulating, generally sub-irrigated within 15 feet, and provide considerable grass and weed competition to trees.

On these flats, most, if not all, species of trees need cultivation for some time to assure successful survival and growth of the plantations. The Station is concentrating its efforts on determining the cheapest method of establishment of various species.

As a result of the work at this branch station, the Experi-

* Maintained in cooperation with the University of Minnesota at the University Farm, St. Paul, Minnesota.

ment Station in 1935 recommended the establishment of a national forest. The National Forest Reservation Commission then approved the purchase of 260,000 acres for a national forest in North Dakota to be administered by Region 9. In order to start the work of afforestation on the area approved for purchase, Region 9 undertook the establishment of a large nursery at Towner. The Denbigh Station, with the experience of five years, was very helpful in getting this nursery started.

Research studies are also being carried out at this Regional nursery on species, seed source, seed treatment and storage, density of sowing, mulching, shading, acidification, fertilization, insect control, root pruning, class of stock, and other investigations having a direct and practical bearing on culture, quality, and cost of both coniferous and broad-leaf stock.

Since the inception of the Shelterbelt Project, studies have been made by this branch station from North Dakota to Texas on the climatic and soil adaptation of various tree and shrub species, and a considerable number of experimental plantings have been started to provide a better basis for grading of stock, site selection, and arrangement and composition of shelterbelts. Observations and plantings have also been made on sandy areas where blowing can be minimized by use of one to three-row shelterbelts which are spaced at distances of ⅛ to ¼ mile and are run in both north-south and east-west directions.

EASTERN FLOODS DAMAGE TREES

The recent severe floods in the eastern section of the country have caused considerable damage to trees a well as to other property. According to an article* in a recent issue of "Science", this damage is attributable to a number of causes. Uprooting and mechanical injury, of course, are among the most numerous types. In some places a more unusual type was found to be due to toxic chemical materials which had escaped into the flood waters. A heavy deposit of crude oil covered the trees in some localities; small trees which were completely submerged escaped this injury as the oil was carried only on the surface of the water. Tall evergreens which were affected by the oil were completely blackened. Another possible source of injury is from chemicals like gasoline which left no visible mark but which may cause considerable damage.

* "*Flood Injury to Trees*" by Malcolm A. McKenzie "Science", Vol. 83, No. 2157, May 1, 1936.

YIELDS OF ASPEN IN THE LAKE STATES

by
Robert T. Anderson

Mature aspen stands measured in the recent forest surveys* of Minnesota and Michigan have been disappointing from the standpoint of volume per acre and average quality.

Aspen, which covers 11,355,000 acres in Minnesota and Michigan, has always been considered one of the most thrifty and rapidly growing species in the Lake States. Normal yield tables show possible yields of 21,000 board feet on medium sites, yet typical volumes found on the forest survey were only 3,000 to 5,000 board feet per acre.

Although there are extensive stands of pulpwood size in the Lake States, companies seeking good quality aspen for matchwood and pulpwood stock are finding it necessary to cull over large areas in order to find the quality of aspen suitable for their purpose.

Among the reasons for disappointing yields are, doubtless:

1. There are fewer merchantable trees per acre in the typical aspen stand than shown in normal yield tables (particularly if cull trees are omitted).
2. The volume of the average tree in a forest stand is less than in a well stocked stand due to poorer form.
3. The volume of an average forest tree is less on account of crooks, rot, and other defects.
4. Current standards of utilization (particularly for pulpwood) are more exacting as to top diameter and minimum size of merchantable trees.

These four points will be discussed in detail in the above order.

Whereas, normal aspen stands at the age of 60 years have from 330 trees per acre on hardwood land to 422 trees per acre on pine land, average stands found on the survey contained only from 215 to 110 sound trees. The decrease is undoubtedly due to ground fires, heart rot, black canker, and other enemies of the species.

The degree of stocking undoubtedly causes the largest reduction in volume, not only due to the fewer merchantable

* The forest surveys referred to are a part of the nation-wide inventory of forest reources now being made by the U. S. Forest Service.

trees on a given area, but also because of the large proportion of short, poor form trees of lower average volume; i.e., a 14 inch tree, from a well stocked stand, contains on the average about 170 board feet, whereas a tree of the same diameter growing in an understocked stand contains on the average only 110 board feet.

To determine the importance of cull trees and cull logs in reduction of the volume and to compare the amount of decadence on different types of land, a special study of aspen was made in Minnesota and Michigan in 1934 and 1935. Approximately 1,500 trees were carefully examined and measured.*

The diameter of rot and taper was measured and each tree was diagrammed for the products for which it was suited. Trees over 10 inches in diameter which did not contain at least a 10 foot log of good quality or a 16 foot log of inferior grade, were designated as cull trees. Similarly, smaller trees without at least two eight-foot sticks of pulpwood, were considered unmerchantable. Table 1 shows the ratio of cull trees to the total of all trees for the different land types by diameter classes.

TABLE 1

PERCENTAGE OF TREES
WHICH ARE CULLS IN ASPEN STANDS

D.B.H.	Cull Percentages On Pine Land		Cull Percentages On Spruce-Balsam Land		Cull Percentages On Hardwood Land	
	Cordwood Stands	Sawlog Stands	Cordwood Stands	Sawlog Stands	Cordwood Stands	Sawlog Stands
6	6	9	5	8	14	40
8	4	15	3	13	7	10
10	5	22	4	18	23	13
12	16	29	12	20	23	16
14	57	35	44	16	-	18
16	85	42	66	24	-	17
18	-	48	-	25	-	-

* Among the workers who have participated in the study, either in the field or in office computations, are Messrs. Kurt Ziebarth, R. K. LeBarron, H. C. Gafvert, J. A. Diemer, and Dr. Frank Kaufert.

The larger aspen trees, particularly on pine land, are very decadent.

In addition to the trees culled outright, a large fraction of the gross volume of merchantable trees had to be discarded as unusable for sawlogs or pulp as judged by current standards of utilization.

Table 2 shows for different size trees in Minnesota, the per cent merchantable and unmerchantable volume based on the total volume to a 4 inch top inside bark.

TABLE 2
PERCENTAGE OF GROSS VOLUME
OF MERCHANTABLE TREES
WHICH IS USABLE FOR SAWTIMBER OR PULPWOOD

D.B.H.	ALL CORDWOOD STANDS				ALL SAWLOG STANDS			
	Usable For Saw-log	Usable For Pulp-wood	Cull	Total	Usable For Saw-log	Usable For Pulp-wood	Cull	Total
	%	%	%	%	%	%	%	%
6	-	28	72	100	-	24	76	100
8	-	74	26	100	-	62	38	100
10	67	14	19	100	61	15	24	100
12	75	6	19	100	73	6	21	100
14	78	3	19	100	78	4	18	100
16		No trees			80	2	18	100
18		No trees			82	2	16	100

The standard of utilization makes a large difference in both sawtimber and pulpwood volume. Normal yield tables for sawtimber (Scribner C) include trees seven inches and larger, whereas the forest survey includes only trees nine inches and larger. For merchantable cordwood volume, the normal yield table includes trees four and six inches in diameter and all volume to a three inch top. The forest survey includes only trees five inches or larger in diameter and only to a three inch top. For pulpwood only the volume below a five inch top is considered usable and of course sawlog volume is excluded.

To make the aspen normal yield tables more readily usable, for typical forest stands, discounted tables (Table 3) have

TABLE III

ASPEN NORMAL YIELD TABLE

ADJUSTED TO FOREST SURVEY STANDARD OF UTILIZATION

Age Years	No. Trees Per Acre 3/	Basal Area Sq. Ft.	Ave. DBH	GROSS VOLUME 1/ Bd. Ft. Scrib.	GROSS VOLUME 1/ Total Cords	NET VOLUME 2/ Bd. Ft. Scrib.	NET VOLUME 2/ Total Cords	NET VOLUME 2/ Pulpwood Cords
				BEST HARDWOOD LAND				
20	1,703	90	3.1	--	3.5	--	2.7	1.6
30	1,054	107	4.3	50	17.3	28	10.8	6.9
40	757	126	5.5	970	36.3	414	20.6	11.8
50	495	137	7.1	3,730	52.1	1,720	31.7	16.2
60	330	145	9.0	12,910	61.1	5,690	43.4	12.1
70	235	152	10.9	21,730	66.5	10,150	50.3	5.2
80	180	156	12.6	25,750	68.5	12,230	52.0	2.4
				SPRUCE BALSAM LAND				
20	1,889	90	3.0	--	2.8	--	2.7	.2
30	1,211	103	3.9	--	12.5	--	9.2	1.5
40	866	123	5.1	325	30.2	106	20.0	4.9
50	570	134	6.6	2,795	46.9	937	30.9	11.3
60	376	142	8.3	9,020	55.7	3,130	37.7	15.1
70	265	146	10.1	16,642	59.4	6,271	39.9	8.7
80	206	152	11.6	21,275	61.5	7,420	40.5	5.1
				PINE LAND				
20	2,062	90	2.8	--	2.1	--	2.3	.3
30	1,363	101	3.7	--	9.9	--	7.8	1.6
40	972	114	4.6	165	22.2	84	16.2	4.4
50	643	125	6.0	1,295	38.2	565	26.6	9.2
60	422	135	7.7	5,515	49.7	1,973	31.2	11.5

1/ Gross Volume includes all living trees
(a) Board Feet Scribner - Trees 9.0" and over to 6" top
(b) Total Cords - Trees 5.0" and over to 3" top.

2/ Net Volume includes only the usable portions of merchantable trees
(a) Board Feet Scribner to variable top-minimum 6"
(b) Cords - to 4" top inside bark
(c) Pulpwood - includes portions of trees suitable for pulpwood to 5" top which have not been utilized for sawlog.

3/ Trees 1" and over.

been prepared on the basis of the average cull factors obtained on the survey and with the utilization standards conforming to those of the Forest Survey. These show volumes varying from 2,000 to 5,700 board feet per acre at 60 years which are more nearly in line with undisturbed natural stands.

The following conclusions are drawn from this special study:

1). The actual volumes in natural aspen stands in the Lake States fall so far behind normal yield tables that the usefulness of the latter is brought into question.

2). An examination of trees and stands measured in connection with the Forest Survey explains the probable reasons.

3). Actual merchantable aspen stands are 40-50 per cent understocked.

4). The average volume per tree is also reduced due to poorer form.

5). Heart rot causes from 16 to 85 per cent of the 14 and 16 inch trees to be useless for the common commercial products - sawlogs, pulpwood, and matchwood. The greatest proportion of cull trees is found on the sandy pine lands.

6). Similar defects destroy the value of 16 to 24 per cent of the gross volume of merchantable trees of sawtimber size.

7). The utilization standards in normal yield tables are higher than common commercial practice.

8). Yield tables discounted to conform to Survey standards and for average cull come fairly close to actual well stocked natural stands.

9). Discounted tables for typical aspen stands on pine, spruce-balsam, and hardwood land are presented.

HURON STAFF VISITS BRANCH STATION

On April 21, Supervisor Murphy of the Huron National Forest and 17 members of his technical staff visited the Lower Peninsula Branch Station at Roscommon, Michigan. Mitchell, of the Experiment Station, explained the various experiments on fire behavior, damage, and control which have been conducted at this Station. The results of the investigations were described and discussed.

Rudolph talked on planting in the Michigan sand plains and

described the studies carried on by the Station on the Huron. The group then visited a number of the experimental plots.

This same program was given a second performance on April 22 for the benefit of the remainder of the Huron technical staff.

THE PRODUCTION OF CERTIFIED NURSERY STOCK

The advantages * of nursery stock grown from seed of known origin have long been known, but all too often such benefits have been sacrificed because of the difficulty of growing or buying such stock. However, in Germany, a federal law requires that certified stock must be used in forest planting in many parts of the country.

Before any seed is collected, the trees from which it is to be taken must be inspected and certified by an agent of the government. If the trees are considered suitable, seed may then be collected. A careful record is kept of the source of all seed.

In the nursery, every bed of seedlings or transplants has a label indicating the origin of the seed. This labeling is required by the Seed Certification Board, a member of which inspects each nursery twice a year. A check of the amount of stock on hand of the various origins is made and compared with the amount of seed which was known to be available to that nursery. Wherever discrepancies occur, the stock cannot be certified, which at the present time practically prevents its sale inside of Germany. The nursery must maintain a set of books in which records of origin are kept and these books must be ready for inspection at any time.

These intensive efforts to improve nursery stock by careful selection of seed sources are expected to result in considerable benefits in the growing of forests by planting.

FORESTS AND TUBERCULOSIS IN THE TENNESSEE VALLEY

An excessively high tuberculosis death-rate in parts of the Tennessee Valley area has been tentatively connected with forest conditions by Dr. C. C. Dauer and L. L. Lumsden at a meeting of the National Tuberculosis Association in New Orleans.

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* This is the third of a series of articles on European nursery practice by H. L. Shirley.

Among many factors investigated as possible sources of the high death-rate, it appeared that the character of the forest vegetation and the soil might have some effect.

The area of high death-rate lies in the southern portion of the Central Hardwood Forest, whereas a little farther south in the Southern Pine Region, the tuberculosis death-rate is much lower. The difference in soil dusts, average sunshine, and dew precipitation may affect the ability of the tuberculosis bacillus to survive outside the human body.

A series of experiments with guinea pigs has been suggested as a test to determine the cause of the high death-rate.

INFLUENCE OF STORAGE CONDITIONS ON WHITE PINE SEED

White pine seed, collected in 1930, was placed in sealed, glass containers and stored for fifteen months at 60°F. In the spring of 1932 representative samples were dried over sulphuric acid to relative humidities of 20, 25, 30, 35 and 40 per cent and resealed. The seed was stored at five different temperatures:

1). Constant 33°F.
2). Constant 41°F.
3). Constant 50°F.
4). Variable (cellar) 33-60°F.
5). Variable (Agronomy seed house) 0-100°F.

The original germination capacity of the seed following stratification in the moist sand at 50°F for twenty days was 59.8, plus or minus 2.7 per cent.

In the fall of 1935, a test of the germinability of these seeds was made (see table below). They were given the same period of stratification as the original sample.

GERMINATION PER CENT OF WHITE PINE SEED
AFTER FIVE YEARS STORAGE

Storage Temperature °F	Relative Humidities 20%	25%	30%	35%	40%
Constant 33°	58.8	62.9	56.0	62.4	62.4
Constant 41°	58.2	47.8	50.1	49.0	52.7
Constant 50°	46.3	42.7	44.4	50.3	53.0
Variable 33-60°	44.3	44.8	51.6	49.5	19.8
Variable 0-100°	4.3	9.2	.08	.08	.6

Approximately 1000 seeds per sample.

White pine seed lost none of its germination capacity after 3½ years storage at 33°F preceded by the fifteen months storage at 60°F. Apparently it does not hold its viability as well at 41°, 50° and 33-60°F, the germination averages of these temperatures showing a progressive decrease. When the seed was not protected from extremes in temperature (0-100°F) viability was essentially lost. This trend was expected since it is known that temperatures over 80°F are detrimental to the germination of white pine seed.

There is no significant influence of the initial degree of desiccation within the range of relative humidities used in these tests. Germination shows a decrease at 40 per cent humidity and 33-60°F and there is some evidence that at the variable temperature of 0-100°F, seeds retain their viability better at 20 and 25 per cent relative humidity.

This experiment indicates, therefore, that white pine seed can be stored for at leat five years at 33°F without sustaining any loss in viability and that the storage moisture has no significance within the present limits unless the average annual temperature is above 50°F. The experiment is being continued.

SOIL EROSION RESEARCH CONFERENCE

The University of Wisconsin, at the request of the Soil Conservation Service, called a meeting to discuss soil erosion research. The conference was held at the Upper Mississippi Soil Erosion Station at La Crosse, Wisconsin, on April 14 and 15. Several Experiment Station members attended as well as representatives from Illinois, Iowa, and Wisconsin.

The discussion centered around the place of the farm woods in the soil conservation program. Four points were emphasized by the Station: (1) Unpastured and undisturbed farm woods are capable of absorbing practically all the precipitation without producing any perceptible runoff or soil loss. (2) Grazed woodlots, on the contrary, present a serious erosion menace. Surface runoff amounted to about 9 per cent of the rainfall, and soil loss during the past summer was around 1600 pounds per acre. (3) Farm woods are a source of revenue and if proper care is used, their economic importance to farmers can be considerably increased. (4) Tree planting is advisable as a soil conservation measure around structures such as soil-saving dams and in gullies or stream banks. The conclusion was that farm woods are of sufficient importance from a soil erosion standpoint to deserve a definite place in the soil conservation program.

DETERMINATION OF CUBIC VOLUME IN THE FIELD

By
S. R. Gevorkiantz

The determination of the cubic volume of felled trees is usually a somewhat lengthy process by any of the methods commonly used (Smalian's Formula, planimeter method) and the computation cannot be easily carried out in the field. There is a definite need for a simple method of computing cubic contents directly on the ground, which will give reasonably accurate results.

A method is presented here which is based on Chebyshef's formula of integration, known to mathematicians since 1873 and widely used by naval architects (1). This formula in its original form is quite complex but when simplified it becomes very easy to use.

For rough estimates of tree volumes, only three measurements are made. The diameters are taken at 1/7, 1/2 and 6/7ths of the total height (2). The cross-sectional areas, corresponding to these measured diameters, are added and this sum is multiplied by one-third of the total height. This rule, although too approximate for tall trees, is nevertheless a very accurate one when applied to short sections. The cubic volume of a 21-foot pole, for example, can be readily determined by measuring diameters at 3, 10½ and 18 feet from either end. If these diameters are 10, 9.2 and 8.5 inches respectively, and their combined cross-sectional area is 1.4 square feet, then the volume of the pole is (21 x 1.4) divided by 3 = 9.8 cubic feet.

The accuracy of Chebyshef's rule depends, of course, on the number of diameter measurements used. It has been found that seven such measurements give good enough results for all practical purposes, especially in the Lake States where timber is relatively short. The diameter measurements should be taken approximately at 5.8, 23.5, 33.8, 50.0, 66.2, 76.5 and 94.2 per cent of the total length of the stem. These points of measurement are well distributed along the stem, characterizing its shape or form. When any of these measurements fall on some large abnormality, two diameters, one on each side of the abnormality

should be measured and averaged. Also, when the first measurement falls below the standard stump, which in practice is considered as a cylinder, the stump diameter instead of the actual measurement should be used. In estimating merchantable volumes, the height from stump to a used top is taken as the total length, and the required diameters are measured beginning from the stump. In estimating peeled volumes, diameters inside of bark are used.

In order to save time in computing volumes directly in the field, the accompanying tables should be used. Table 1 shows where the points of measurement should be taken for trees of any given height. If, for example, a tree is 58 feet tall, or in the case of estimating merchantable volumes, its used length is 58 feet, then the first measurement should be taken at 3.5 feet above the base (ground line or stump line, as the case may be), second measurement at 13.5 feet above the base, and so forth. Table 2, in turn, gives values of basal areas corresponding to diameters measured at the points of the stem as indicated by Table 1, already divided by seven, or the number of diameter measurements used. The application of these tables can be illustrated by an example. Suppose it is required to determine the total unpeeled volume of a tree, 44 feet tall. The diameters measured at the points indicated by Table 1, are: 7.9, 6.6, 6.1, 5.4, 3.8, 2.9 and 1.3 inches respectively. From Table 2, the values corresponding to these diameters are next read and summed up. Thus: 0.0486 + 0.0339 + 0.0290 + ... + 0.0013 = 0.1534. The last step in the operation is to multiply 0.1534, by 44, which is the total height. The product, 6.75, is the required cubic volume of the tree.

Literature Cited

(1) Whittaker, E. T. and Robinson, G. 1932.
The Calculus of Observations. Ed. 2 395 pp. London and Glasgow.

(2) Tursky, G. M. 1927.
Forest Mensuration. 211 pp. Moscow (Russian).

TABLE 1

POINTS OF MEASUREMENT FOR TREES OF DIFFERENT HEIGHTS

Total Ht. Feet	Points Of Measurement In Feet Above Base						
	1st	2nd	3rd	4th	5th	6th	7th
20	1.0	4.5	7.0	10.0	13.0	15.5	19.0
25	1.5	6.0	8.5	12.5	16.5	19.0	23.5
30	1.5	7.0	10.0	15.0	20.0	23.0	28.5
32	2.0	7.5	11.0	16.0	21.0	24.5	30.0
34	2.0	8.0	11.5	17.0	22.5	26.0	32.0
36	2.0	8.5	12.0	18.0	24.0	27.5	34.0
38	2.0	9.0	13.0	19.0	25.0	29.0	36.0
40	2.5	9.5	13.5	20.0	26.5	30.5	37.5
42	2.5	10.0	14.0	21.0	28.0	32.0	39.5
44	2.5	10.5	15.0	22.0	29.0	33.5	41.5
46	2.5	11.0	15.5	23.0	30.5	35.0	43.5
48	3.0	11.5	16.0	24.0	32.0	36.5	45.0
50	3.0	12.0	17.0	25.0	33.0	38.0	47.0
52	3.0	12.0	17.5	26.0	34.5	40.0	49.0
54	3.0	12.5	18.5	27.0	35.5	41.5	51.0
56	3.5	13.0	19.0	28.0	37.0	43.0	52.5
58	3.5	13.5	19.5	29.0	38.5	44.5	54.5
60	3.5	14.0	20.5	30.0	40.0	46.0	56.5
62	3.5	14.5	21.0	31.0	41.0	47.5	58.5
64	3.5	15.0	21.5	32.0	42.5	49.0	60.5
66	4.0	15.5	22.5	33.0	43.5	50.5	62.0
68	4.0	16.0	23.0	34.0	45.0	52.0	64.0
70	4.0	16.5	23.5	35.0	46.5	53.5	66.0
72	4.0	17.0	24.5	36.0	47.5	55.0	68.0
74	4.5	17.5	25.0	37.0	49.0	56.5	70.0
76	4.5	18.0	25.5	38.0	50.5	58.0	71.5
78	4.5	18.5	26.5	39.0	51.5	59.5	73.5
80	4.5	19.0	27.0	40.0	53.0	61.0	75.5
82	5.0	19.5	27.5	41.0	54.5	62.5	77.0
84	5.0	20.0	28.5	42.0	55.5	64.0	79.0
86	5.0	20.0	29.0	43.0	57.0	66.0	81.0
88	5.0	20.5	29.5	44.0	58.5	67.5	83.0
90	5.0	21.0	30.5	45.0	59.5	69.0	85.0

TABLE 2

BASAL AREA FACTORS

Diameter Inches	Diameter - Tenths of Inches									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	Square Feet									
1	.0008	.0009	.0011	.0013	.0015	.0018	.0020	.0023	.0025	.0028
2	.0031	.0034	.0038	.0041	.0045	.0049	.0053	.0057	.0061	.0066
3	.0070	.0075	.0080	.0085	.0090	.0095	.0101	.0107	.0113	.0119
4	.0125	.0131	.0137	.0144	.0151	.0158	.0165	.0172	.0180	.0187
5	.0195	.0203	.0211	.0219	.0227	.0236	.0244	.0253	.0262	.0271
6	.0281	.0290	.0300	.0309	.0319	.0329	.0339	.0350	.0360	.0371
7	.0382	.0393	.0404	.0415	.0427	.0438	.0450	.0462	.0474	.0486
8	.0499	.0511	.0524	.0537	.0550	.0563	.0576	.0590	.0603	.0617
9	.0631	.0645	.0659	.0674	.0688	.0703	.0718	.0733	.0748	.0764
10	.0779	.0795	.0811	.0827	.0843	.0859	.0875	.0892	.0909	.0926
11	.0943	.0960	.0977	.0995	.1013	.1030	.1048	.1067	.1085	.1103
12	.1122	.1141	.1160	.1179	.1198	.1217	.1237	.1257	.1277	.1297
13	.1317	.1337	.1358	.1378	.1399	.1420	.1441	.1462	.1484	.1505
14	.1527	.1549	.1571	.1593	.1616	.1638	.1661	.1684	.1707	.1730
15	.1753	.1777	.1800	.1824	.1848	.1872	.1896	.1921	.1945	.1970
16	.1995	.2020	.2045	.2070	.2096	.2121	.2147	.2173	.2199	.2225
17	.2252	.2278	.2305	.2332	.2359	.2386	.2414	.2441	.2469	.2497
18	.2524	.2553	.2581	.2609	.2638	.2667	.2696	.2725	.2754	.2783
19	.2813	.2842	.2872	.2902	.2932	.2963	.2993	.3024	.3055	.3086
20	.3117	.3148	.3179	.3211	.3243	.3274	.3306	.3339	.3371	.3403

THE STATION'S LIBRARY

The Experiment Station has a very extensive and up-to-date library at its main office in St. Paul. It is particularly strong in bulletins and pamphlets, both domestic and foreign. It is estimated that there are 11,000 of these. They are indexed by author and according to subject matter. The Station also maintains an extensive file of manuscripts and reports dealing with experiments at other forest experiment stations and research agencies. In addition, over three hundred reference books on forestry and closely related subjects are in use at the Station. Besides its own library, the Station staff has access to the libraries of the Farm School and the Main Campus of the University of Minnesota.

These library facilities are, of course, the most important tool of the research staff of the Station. We realize how handicapped a field man must be by not being able to consult the literature in the field of investigation which he, himself, may undertake. The station, therefore, wishes to offer this service to field men. If any field man writes to us about his particular investigation we shall be glad to give him references to what has been done in this field, and if the material cannot be obtained easily, some special arrangement may be made for him to consult the material available in the library.

ADMINISTRATIVE RESEARCH ON THE MANISTEE

The Manistee National Forest has started a comprehensive experiment with pot planting in an effort to devise a planting technique which will make it possible to carry on planting operations throughout the summer.

The type of pot used is made from heavy tar paper such as is used in the building trades. Three different sizes are being tried out, ranging from 1 to 2 inches square and 6 inches deep. The seed is sown directly in the pots and field planting of the pots will be begun as soon as germination is completed and the seed coat has disappeared. Some pots will be planted each day for five days each week for a period of ten weeks. The pots will be set out under different site conditions. Half of each day's planting will be made with pots which have had their bottoms removed and half with whole pots in order to compare the effect on root development. Tests will also be conducted to determine how efficient the pots are in reducing

damage by white grubs.

In addition, studies will be made on the effect of soil scarification beneath white pine and jack pine seed trees on the establishment of reproduction. Another experiment will be carried out to determine the effect of poor planting on the growth and survival of trees, and to determine the degree and effect of the filling-in of soil in planting furrows.

THIRTY YEARS OF THINNING WHITE PINE

A series of thinning plots in a second growth white pine stand near Keene, New Hampshire was established by the Forest Service in 1905. Until 1915 they were maintained and remeasured by the Forest Service, but after that the plots were turned over to the Yale School of Forestry, which has recently published a bulletin* describing the results.

Some of the thinned plots were not carried throughout the entire thirty-year period and the bulletin therefore is devoted to a comparison of a check plot and a heavily thinned plot which received six thinnings.

From the standpoint of volume production the most striking point is that there was very little difference in the total volume of wood produced by the two stands if the volume removed in thinning is added to the present volume of the thinned stand. The unthinned stand has a present volume of 41,640 board feet per acre and the thinned stand has a volume of 21,070 board feet to which should be added 21,610 board feet removed in the various thinnings, thus making a total of 42,680 board feet. However, there is a very marked difference in the volume of material in trees 10 inches and larger; 29,634 board feet per acre were produced in trees 10 inches and over on the thinned plot compared with 26,452 board feet on the unthinned plot. This gives the thinned plot a decided financial advantage.

Aside from mere volume growth, however, the thinned plot is even further ahead of the unthinned. The soil in the thinned stand has been improved over that in the unthinned chiefly by increases in soil temperature and moisture, and by the addition of hardwood leaf litter which reduces acidity and increases fertility.

**Observations on Thinning and Management of Eastern White Pine in Southern New Hampshire* by R. C. Hawley, Bulletin No. 42 of Yale University: School of Forestry. 1936.